CLAIMS

1. A wireless communication system comprising:

a base station; a plurality of terminals; and a control unit,

wherein said base station and each of said plurality of terminals are operable to simultaneously perform space division multiplex wireless transmission of information using a same frequency,

wherein at least one of said plurality of terminals communicates with said base station via a plurality of propagation paths,

wherein said base station comprises a base station multi-beam antenna used for the space division multiplex wireless transmission,

wherein said base station multi-beam antenna comprises a plurality of base station antenna elements,

wherein each of said plurality of terminals comprises a terminal multi-beam antenna used for the space division multiplex wireless transmission,

wherein said terminal multi-beam antenna comprises a plurality of terminal antenna elements, and

wherein said control unit is operable to orthogonalize a beam pattern of said base station multi-beam antenna, thereby controlling the space division multiplex wireless transmission.

2. The wireless communication system as claimed in claim 1, wherein said control unit is operable to orthogonalize the beam pattern of said base station multi-beam antenna based on a plurality of transfer function values determining a radio-wave-propagation characteristic between said plurality of base station antenna elements and said plurality of terminal antenna elements.

3. The wireless communication system as claimed in claim 1, wherein a number of said base station antenna elements is greater than a maximum number of

said terminal antenna elements among said plurality of terminals.

4. The wireless communication system as claimed in claim 2, wherein each of said plurality of terminals is operable to transmit, to said base station, pilot signals to be used for estimation of a radio-wave-propagation characteristic between each of said plurality of terminals and said base station,

wherein said base station is operable to receive the pilot signals, and

wherein said control unit is operable to calculate the plurality of transfer function values based on the pilot signals.

5. The wireless communication system as claimed in claim 2, wherein said control unit is operable to calculate eigenvectors of a channel matrix whose matrix elements are composed of the plurality of transfer function values, and

wherein said control unit is operable to control a set of weight to be imposed on said plurality of base station antenna elements using the eigenvectors of the channel matrix.

6. The wireless communication system as claimed in claim 2, wherein said control unit is operable to calculate a plurality of diagonal elements of a channel matrix whose matrix elements are composed of the plurality of transfer function values, and

wherein said control unit is operable to control a set of weight to be imposed on said plurality of base station antenna elements using the plurality of diagonal elements of the channel matrix.

7. The wireless communication system as claimed in claim 2, wherein, when one of said plurality of terminals has moved, the one of said plurality of terminals is operable to transmit, to said base station, movement pilot signals to be used for estimating a radio-wave-propagation characteristic between said one of said plurality of terminals and said base station, said base station is operable to receive the movement pilot signals, said control unit is operable to re-calculate a plurality of transfer function values concerning the one of said plurality of terminals, and said

control unit is operable to orthogonalize the beam pattern of said base station multi-beam antenna based on the plurality of re-calculated transfer function values.

8. The wireless communication system as claimed in claim 7, wherein said control unit is operable to re-calculate a plurality of transfer function values concerning one or more un-moved terminals, the one or more un-moved terminals belonging to said plurality of terminals.

9. The wireless communication system as claimed in claim 7, wherein said control unit is not operable to re-calculate a plurality of transfer function values concerning one or more un-moved terminals, the one or more un-moved terminals belonging to said plurality of terminals.

10. The wireless communication system as claimed in claim 7, wherein said control unit, utilizing mobility as a parameter indicating degree that one of said plurality of terminals has moved in space per unit time, is operable to determine priority of orthogonalization of said base station multi-beam antenna.

11. The wireless communication system as claimed in claim 10, wherein said control unit is operable to determine the priority of orthogonalization of said base station multi-beam antenna such that priority of one of said plurality of terminals having certain mobility is higher than priority of another of said plurality of terminals having mobility greater than the certain mobility.

12. The wireless communication system as claimed in claim 10, wherein the mobility of said plurality of terminals is expressed in terms of respective identifiers given to said plurality of terminals, said plurality of terminals are operable to transmit to said base station the respective identifiers, said control unit is operable to receive the respective identifiers transmitted from said plurality of terminals, and said control unit is operable to determine the priority of orthogonalization of said base station multi-beam antenna based on the respective identifiers received by said base station.

13. The wireless communication system as claimed in claim 1, wherein said

control unit is provided within said base station.

14. A base station for a wireless communication system comprising said base station and a plurality of terminals, said base station and said plurality of terminals simultaneously performing space division multiplex wireless transmission of information using a same frequency, each of said plurality of terminals comprising a plurality of terminal antenna elements, said base station comprising:

a base station multi-beam antenna comprising a plurality of base station antenna elements; and

an antenna-controlling unit operable to control the space division multiplex wireless transmission via said plurality of base station antenna elements,

wherein said antenna-controlling unit is operable to calculate a plurality of transfer function values determining a radio-wave-propagation characteristic between said plurality of base station antenna elements and said plurality of terminal antenna elements to orthogonalize a beam pattern of said base station multi-beam antenna based on the determined radio-wave-propagation characteristic.

15. The base station as claimed in claim 14, wherein said base station further comprising: an interference amount-estimating unit operable to estimate an interference amount in a pair of propagation paths between said plurality of terminals and said base station,

wherein said antenna-controlling unit is operable to determine a beam pattern of said base station multi-beam antenna based on the interference amount estimated by said interference amount-estimating unit.

16. The base station as claimed in claim 14, wherein said base station further comprising: a mobility-identifying unit operable to identify mobility of each of said plurality of terminals, the mobility indicating degree that one of said plurality of terminals has moved in space per unit time,

wherein said antenna-controlling unit is operable to determine a beam pattern

of said base station multi-beam antenna based on the mobility identified by said mobility-identifying unit.

17. A terminal for a wireless communication system comprising a base station and a plurality of terminals, each of said plurality of terminals being composed of said terminal, said plurality of terminals and said base station simultaneously performing space division multiplex wireless transmission of information using a same frequency with each other, said terminal comprising:

a terminal multi-beam antenna comprising a plurality of terminal antenna elements; and

a pilot signal-generating unit operable to generate pilot signals used for estimation of a radio-wave-propagation characteristic between said base station and said terminal,

wherein said terminal multi-beam antenna is operable to transmit to said base station the pilot signals generated by said pilot signal-generating unit.

18. The terminal as claimed in claim 17, wherein said terminal further comprising: an antenna-controlling unit operable to control wireless communications via said plurality of terminal antenna elements, and

wherein said antenna-controlling unit is operable to cancel, after said base station has orthogonalized a beam pattern thereof, an interference wave utilizing at least one of a zero forcing method and a maximum likelihood estimation method.

19. A wireless communication method operable to simultaneously perform space division multiplex wireless transmission of information using a same frequency between a base station and a plurality of terminals, the base station comprising a base station multi-beam antenna including a plurality of base station antenna elements, each of the plurality of terminals comprising a terminal multi-beam antenna including a plurality of terminal antenna elements, said method comprising:

communicating between at least one of the plurality of terminals and the base

station via a plurality of propagation paths;

transmitting pilot signals used for estimation of a radio-wave-propagation characteristic from each of the plurality of terminals to the base station;

calculating a plurality of transfer function values of a radio-wave-propagation characteristic between the plurality of base station antenna elements of the base station and the plurality of terminal antenna elements of the plurality of terminals based on the pilot signals; and

orthogonalizing a beam pattern of the base station multi-beam antenna based on the plurality of transfer function values of the radio-wave-propagation characteristic.

20. The wireless communication method as claimed in claim 19, wherein a number of the base station antenna elements is greater than a maximum number of the terminal antenna elements among the plurality of terminals.

21. The wireless communication method as claimed in claim 19, wherein said calculating including calculating eigenvectors of a channel matrix whose matrix elements are composed of the plurality of transfer function values, and

wherein said orthogonalizing including controlling a set of weight to be imposed on the plurality of base station antenna elements using the eigenvectors of the channel matrix.

22. The wireless communication method as claimed in claim 19, wherein said calculating including calculating a plurality of diagonal elements of a channel matrix whose matrix elements are composed of the plurality of transfer function values, and

wherein said orthogonalizing including controlling a set of weight to be imposed on the plurality of base station antenna elements using the plurality of diagonal elements of the channel matrix.

23. The wireless communication method as claimed in claim 19, further comprising: when one of the plurality of terminals has moved, transmitting, from the

one of the plurality of terminals to said base station, movement pilot signals to be used for estimating a radio-wave-propagation characteristic between the one of said plurality of terminals and the base station; receiving the movement pilot signals; re-calculating a plurality of transfer function values concerning the one of the plurality of terminals; and orthogonalizing the beam pattern of the base station multi-beam antenna based on the plurality of re-calculated transfer function values.